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NATIONAL DAM INSPECTION PROGRAM. BRANDONVILLE PUMPING STATION D--ETC(U)
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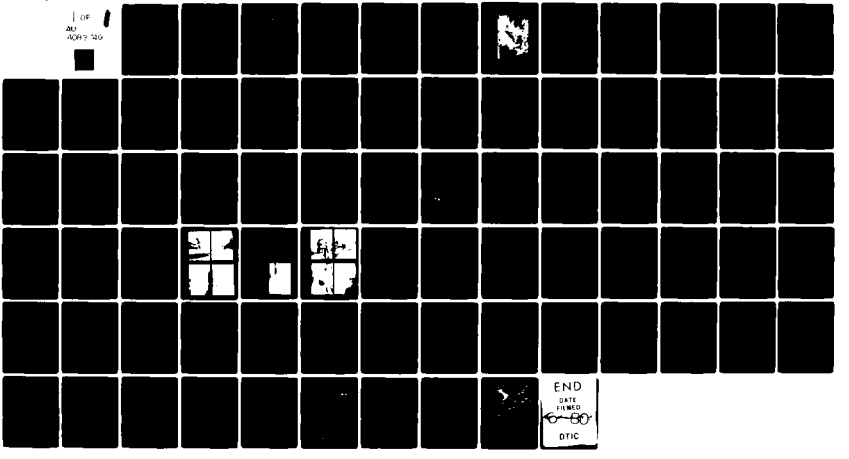

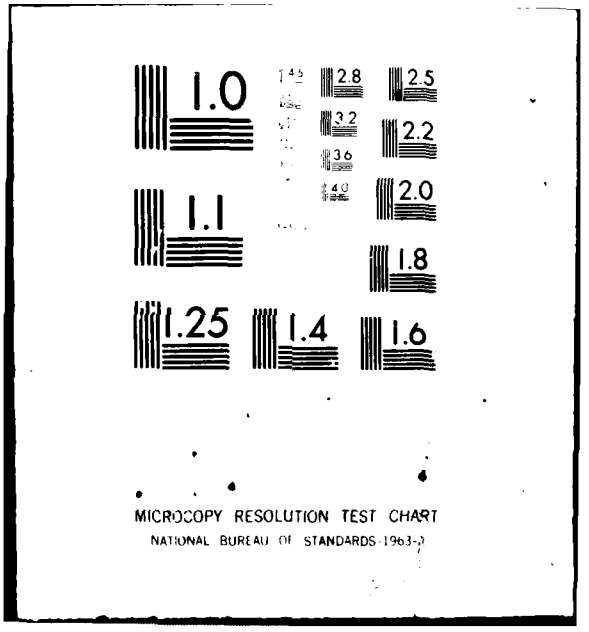
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SUSQUEHANNA RIVER BASIN

DAVIS RUN, SCHUYLKILL COUNTY

PENNSYLVANIA

BRANDONVILLE PUMPING STATION DAM

NDS ID NO. PA-661

DER ID NO. 54-48

BOROUGH OF SHENANDOAH

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared By

L. ROBERT KIMBALL & ASSOCIATES

CONSULTING ENGINEERS & ARCHITECTS

EBENSBURG, PENNSYLVANIA

15931

FOR

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT CORPS OF ENGINEERS

BALTIMORE, MARYLAND

21203

MARCH, 1980

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SUSQUEHANNA RIVER BASIN

DAVIS RUN, SCHUYLKILL COUNTY

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PENNSYLVANIA

National Dam Inspection Program

BRANDONVILLE PUMPING STATION DAM

(NDS ID ~~NO.~~ PA-661 Number

DER ID ~~NO.~~ 54-48)

Susquehanna River Basin, Davis Run,

BOROUGH OF SHENANDOAH

Schuylkill County, Pennsylvania.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

12 017

10 R. Jeffrey / Kimball

Prepared By

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JEB

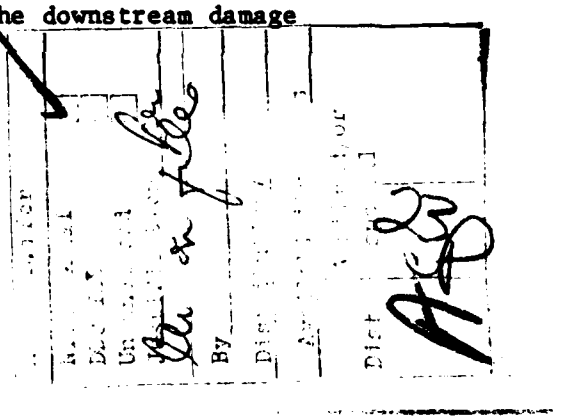
PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Brandonville Pumping Station
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Schyulkill
STREAM	Davis Run
DATE OF INSPECTION	November 6 and 16, 1979

ASSESSMENT

The assessment of Brandonville Pumping Station Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

The inspection and review of data of Brandonville Pumping Station Dam did not reveal any problems which require emergency action. The dam appears to be in fair condition but poorly maintained.

Brandonville Pumping Station Dam is a high hazard-small size dam. The spillway design flood is the PMF (probable maximum flood). The spillway and reservoir are capable of controlling 6% of the PMF. Based on criteria established by the Corps of Engineers, the spillway is termed inadequate, but not seriously inadequate.

The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design and construction to increase spillway capacity.

2. A stability analysis of the downstream slope wall should be conducted by a registered professional engineer knowledgeable in earth dams.

3. Remove bridge over spillway.

4. The trees on the crest and downstream slope should be selectively removed under the guidance of a professional engineer knowledgeable in dam design and construction.

5. Perform periodic repairs of cracks and deterioration in the spillway.

6. Valves should be repaired. They should be operated and lubricated on a regular basis.

7. Repair the downstream slope masonry.

8. Investigate the cause of the flooded valve chamber and eliminate the problem. Positive drainage should be provided at the toe of dam so the tailwater does not back up against the toe of the dam. If seepage exists it should be monitored on a regular basis and reviewed by a registered professional engineer knowledgeable of earth dams.

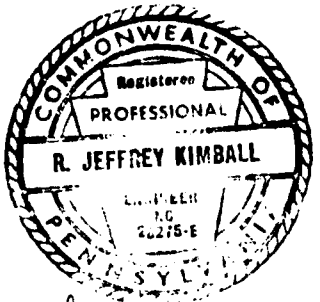
9. Some means of positive closure of the drainline should be developed in case of emergencies.

10. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

11. Regular safety inspections should be conducted in accordance with the provisions stipulated by the Commonwealth of Pennsylvania regarding the inspection of dams.

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS



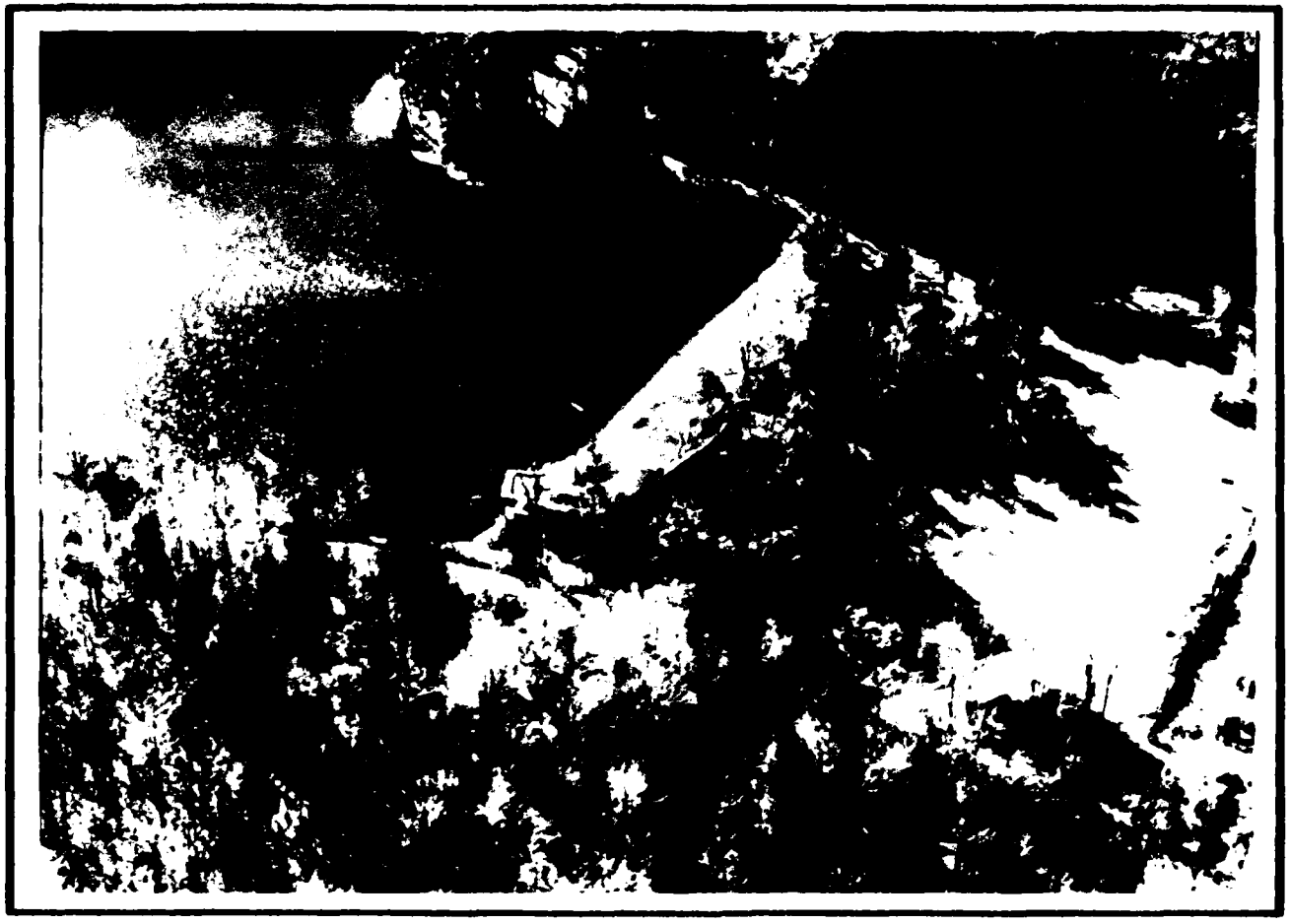
March 18, 1980
Date

R. Jeffrey Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

25 March 1980
Date

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



Overview of Brandonville Pumping Station from right abutment.

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
BRANDONVILLE PUMPING STATION DAM
NDI. I.D. NO. PA 661
DER I.D. NO. 54-48

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Brandonville Pumping Station Dam is an earthfill dam, 374 feet long and approximately 21 feet high. The top width varies from approximately 24 feet to 52 feet. The upstream slope is 1.5H:1V and protected with grouted riprap. The downstream slope is formed by a dry masonry wall and varies from 1H:1V to nearly vertical. A 4 foot wide walkway is provided near the center of the downstream slope at the right abutment.

A valve house is located approximately 90 feet from the right abutment near the downstream slope of the dam. This valve house controls the reservoir drain. Entrance to the valve house is provided through a door on the downstream slope of the dam. The valve house is beneath the embankment. A valve chamber is located immediately downstream of the valve house adjacent to the toe of dam. The size and type of reservoir drain are unknown.

The spillway is located on the right abutment and consists of a grouted masonry lined overflow. The spillway is 40 feet wide and near ogee in shape. The spillway has a puddle trench center core.

b. Location. The dam is located on Davis Run, approximately 4.5 miles east of Ringtown, Schuylkill County, Pennsylvania. Brandonville Pumping Station Dam can be located on the Shenandoah, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Brandonville Pumping Station Dam is a small size structure (21 feet high, 70 acre-feet).

d. Hazard Classification. Brandonville Pumping Station Dam is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail. Several dwellings are located .6 miles downstream of the dam.

e. Ownership. Brandonville Pumping Station Dam is owned by the Borough of Shenandoah. Correspondence should be addressed to:

Borough of Shenandoah
Borough Building
Shenandoah, PA 17916
Attention: Connie Reese
717-462-1918

f. Purpose of Dam. Brandonville Pumping Station Dam is used for recreation.

g. Design and Construction History. No information is available on the design or construction history. It is believed that the dam was constructed around 1900.

h. Normal Operating Procedure. A fish hatchery is located approximately 300 feet downstream of the dam. Water is fed to the fish hatchery by gravity through an unlocated pipe through the dam. No information was available on the type, location and operation the outlet works. The fish hatchery and the dam are used by a sportsman club. The excess water which is not fed to the fish hatchery is discharged over the spillway crest. The owner stated that no operations are conducted at the dam.

1.3 Pertinent Data.

a. Drainage Area. 2.9 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	356

c. Elevation (U.S.G.S. Datum) (feet). - Field survey based on pool elevation 986 shown on USGS 7.5 minute quadrangle.

Top of dam - low point	987.9
Top of dam - design height	Unknown
Maximum pool - PMF	991.6
Normal pool	986.0

Spillway crest	986.0
Streambed at centerline of dam	967.0
Tailwater on day of inspection	968.4
Toe of dam	968.4

d. Reservoir (feet).

Length of maximum pool (PMF)	1300
Length of normal pool	1200

e. Storage (acre-feet).

Normal pool	62
Top of dam	70

f. Reservoir Surface (acres).

Top of dam	4
Normal pool	3.7
Spillway crest	3.7

g. Dam.

Type	Earthfill
Length	374'
Height	21'
Top width	Varies (24-52')
Side slopes - upstream	1.5H:1V to vertical
- downstream	Varies
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Reservoir Drain.

Type	Unknown
Length	Approximately 60 feet
Closure	Valve at toe
Access	None
Regulating facilities	Valve at toe

i. Spillway.

Type	Ogee
Length	40
Crest elevation	986
Upstream channel	Unrestricted
Downstream channel	Open channel

SECTION 2
ENGINEERING DATA

2.1 Design. Review of information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources reveal that several inspection reports, some correspondence and photographs were available for review. No design data, construction drawings or history of the dam were contained in the files. The owner had no data on the dam. The DER files were reviewed for this study.

2.2 Construction. No information is available on construction of the dam.

2.3 Operation. No operating records are maintained.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterways Management. The owner stated that no operation or maintenance is conducted at the dam. The owner did not accompany the inspection team during the inspection.

b. Adequacy. The type and amount of design data and other information are very minimal. The Phase I Report is based on the visual inspection and hydrologic and hydraulic analyses.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Brandonville Pumping Station Dam was conducted by personnel of L. Robert Kimball and Associates on November 6 and 16, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in fair condition. From a brief survey conducted during the inspection, it was noted that the crest of dam rises toward the left abutment. The low spot on the dam is adjacent to the spillway. The upstream slope was measured to be 1.5H:1V and covered with grouted riprap. The crest width varied from 24 to 52 feet wide and was grassed. The downstream slope consisted of a dry masonry wall varying from 1H:1V to vertical. A 4 foot wide walkway is provided at the midpoint of the downstream slope near the right abutment. Several trees were growing on the crest of dam. The wall appeared to be bulging at the maximum section.

A 6 inch cast iron pipe is located on the upstream slope of the dam. Based on old photographs contained in the PennDER files this pipe was used to pump water into the reservoir. The abandoned pump house is located approximately 50 feet beyond the toe of dam. Portions of the large discharge pipe to pump water to Shenandoah Borough are visible near the left abutment.

c. Appurtenant Structures. The reservoir level at the time of inspection was approximately 986.2. The spillway appeared to be in fair condition. The spillway consists of a grouted masonry overflow section with a puddle center core. The masonry appears to have been laid over earth materials (based on old photographs of spillway repairs). This spillway is near ogee in shape. A leak was present on the right spillway wall. A wooden foot bridge is present over the spillway near the control section. The foot bridge is above the low point on the top of dam and may collect debris during flooding and cause blockage. This bridge is not essential.

The reservoir drain is controlled in a valve house which is located inside the embankment approximately 90 feet from the spillway. Access to this valve house is through a doorway at

the toe of dam. At the time of inspection the valve house was flooded and could not be entered. It appeared that the flooded water was from seepage through the embankment, a deteriorated valve or piping system or from tailwater backing up into the valve house. Immediately downstream of the valve house is another valve chamber. This valve chamber has a concrete lid which was seeping during the inspection.

d. Reservoir Area. The watershed is covered mostly with woodland. The reservoir slopes are moderate to steep but do not appear to be susceptible to massive landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel of Davis Run is moderately wide for approximately 900 feet before it flows into Catawissa Creek. Catawissa Creek channel is wide but meandering.

3.2 Evaluation. The embankment appeared to be in fair condition. The spillway and outlet works appear to be in poor condition. The dam and appurtenant structures are not operated or maintained.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. Water is drawn off the reservoir through the outlet works to feed the fish hatchery located downstream of the dam. According to the owner the outlet works are not operated. The reservoir is maintained at the spillway crest elevation 986.0. The excess inflow discharges over the spillway crest. The reservoir drain is not operated.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is non-existent according to the owner. Maintenance of the dam is considered poor.

4.3 Maintenance of Operating Facilities. The operating facilities are not maintained. Maintenance of these operating facilities is considered poor.

4.4 Warning System in Effect. There is no system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities is considered poor. There is no warning system in effect to warn downstream residents.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to hydrology were available.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in fair condition. The control section consists of a concrete weir with occassional steel reinforcing positioned vertically. The reinforcing steel was part of a flashboard system. The spillway overflow section is ogee shaped.

A low spot was noted on the dam embankment near the left spillway wingwall. This area could easily be filled to the top of dam elevation.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. A pool elevation 986.0 was assumed prior to the storm.

2. For the dam breach analysis it was assumed that dam failure would begin when the water level in the reservoir reached elevation 989.0 or 1.10 feet over the top of the dam.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	6290 cfs
Spillway capacity	356 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for this dam is the PMF. The SDF is based on the hazard and size classification of the dam. Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

> Inadequate - All high hazard dams which do not pass the SDF (PMF) but where failure due to overtopping does not significantly increase the hazard potential for loss of life downstream.

The spillway and reservoir are capable of controlling approximately 6% of the PMF without overtopping the dam (based on low spot elevation).

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analyses) it was necessary to perform a breach analysis and downstream routing of the flood wave. This analysis determines the degree of flooding due to dam failure.

The flood wave was routed downstream with and without embankment failure conditions considered. The dam breach analysis parameters are included in Appendix D.

Results of the Dam Breach analysis indicate that downstream flooding is not significantly increased. Since flooding downstream is not significantly increased due to dam failure, according to the Corps of Engineers definitions the spillway is not considered seriously inadequate. Therefore, this spillway is rated as "inadequate".

The water level in the reservoir at the time of dam failure was assumed to be at 989.0 feet (1.10 feet over the top of dam) based on the evaluating engineers judgement. The 20% PMF was routed through the reservoir and downstream.

Note: Future development within the watershed, at the dam, or downstream may change characeristics and assumptions made for this study and different results are likely. Future development downstream may also greatly increase the potential for loss of life due to failure of the structure.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No signs of slumping or erosion were noted during the inspection. The downstream slope is formed by a dry masonry wall. This dry masonry wall appeared to be bulging at the maximum section (close to the possible seepage area). No signs of seepage was noted on the downstream slope. However, entrance to the valve house is not possible since it is flooded. This water may be from seepage through the embankment, leakage through the reservoir drain or valves or from tailwater backing into the valve house. In addition, the valve chamber is leaking.

b. Design and Construction Data. No design or construction data is available. No stability analyses have been conducted for this dam.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. No post construction changes are known other than constructing the slurry trench beneath the spillway in 1914.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in fair condition but poorly maintained. The outlet works and reservoir drain are not operated. The downstream slope wall appeared to be bulging near the maximum section (near the possible seepage area). Seepage is present in the valve house and valve chamber. The visual observations, review of available data, hydrologic and hydraulic calculations and past operational performance indicate that Brandonville Pumping Station Dam's spillway is inadequate, but not seriously inadequate. The spillway is capable of controlling 6% of the PMF without overtopping the embankment. No adequate stability analyses have been performed for this structure.

b. Adequacy of Information. Sufficient information is available to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design and construction to increase spillway capacity.

2. A stability analysis of the downstream slope wall should be conducted by a registered professional engineer knowledgeable in earth dams.

3. Remove bridge over spillway.

4. The trees on the crest and downstream slope should be selectively removed under the guidance of a professional engineer knowledgeable in dam design and construction.

5. Perform periodic repairs of cracks and deterioration in the spillway.

6. Valves should be repaired. They should be operated and lubricated on a regular basis.

7. Repair the downstream slope masonry.

8. Investigate the cause of the flooded valve chamber and eliminate the problem. Positive drainage should be provided at the toe of dam so the tailwater does not back up against the toe of the dam. If seepage exists it should be monitored on a regular basis and reviewed by a registered professional engineer knowledgeable of earth dams.

9. Some means of positive closure of the drainline should be developed in case of emergencies.

10. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

11. Regular safety inspections should be conducted in accordance with the provisions stipulated by the Commonwealth of Pennsylvania regarding the inspection of dams.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Brandonville Pumping Station Dam COUNTY Schyulkill STATE Pennsylvania ID# PA 661

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION Nov. 6 and 16, 1979 WEATHER Cloudy, warm TEMPERATURE 50°

POOL ELEVATION AT TIME OF INSPECTION 986.2 M.S.L. TAILWATER AT TIME OF INSPECTION 968.4 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

James T. Hockensmith

RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No erosion or sloughing noted. Masonry walls are deteriorating and need maintenance.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Low spot adjacent to the spillway. Crest rises toward left abutment. Horizontal alignment appears all right.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	One tree on crest and several trees on the downstream slope.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good.	
ANY NOTICEABLE SEEPAGE	Valve house inside embankment is flooded and seepage is present at valve chamber adjacent to toe of dam.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Type of outlet works and reservoir drain are unknown. Reservoir drain is controlled in valve house inside toe of dam.	
INTAKE STRUCTURE	Unknown.	
OUTLET STRUCTURE	None.	
OUTLET CHANNEL	Davis Run.	
EMERGENCY GATE	Valve in valve house which was flooded.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Appears to be in good condition.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	Grouted masonry overflow. Some cracking and deterioration of concrete.	
BRIDGE AND PIERS	Walk bridge at spillway weir.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

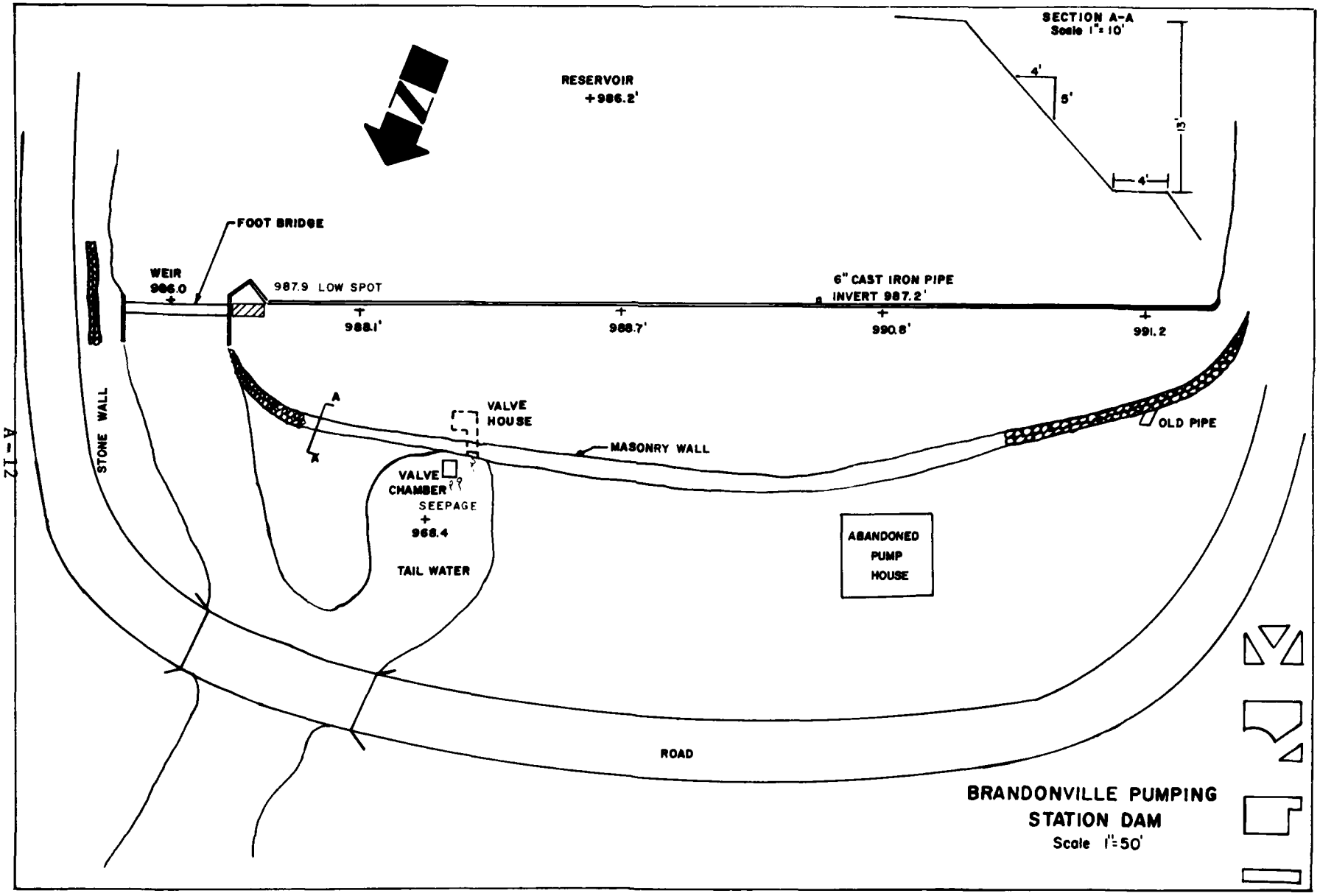
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Moderately wide for 900 feet before entering Catawissa Creek.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 2 homes - 8 people within .6 miles of dam. Both of these houses are on Catawissa Creek.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderately steep. Appear to be stable.	
SEDIMENTATION	Does not appear to be excessive.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	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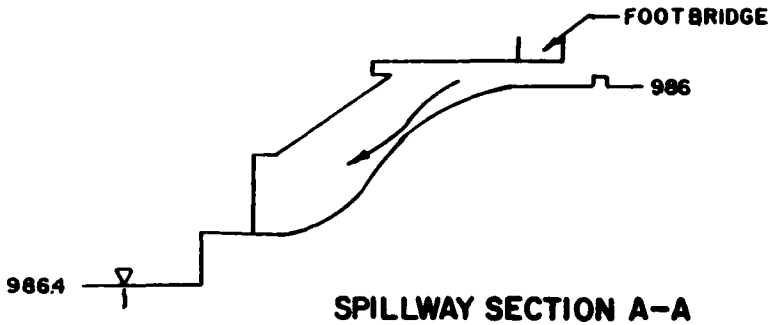
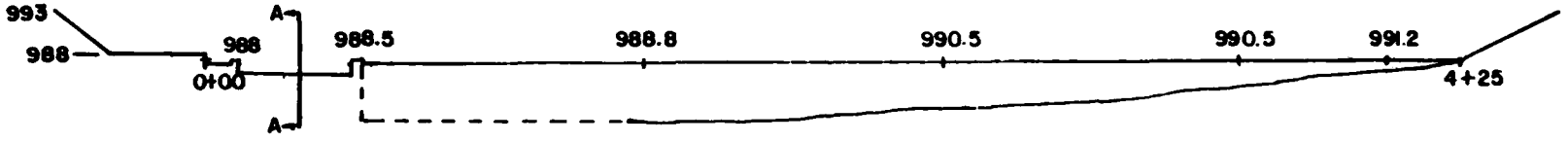
5'
13'
4'
RESERVOIR
+986.2'
FOOT BRIDGE
WEIR
986.0
987.9 LOW SPOT
6" CAST IRON PIPE
INVERT 987.2'
988.1'
988.7'
990.8'
991.2
STONE WALL
A
A
VALVE
HOUSE
MASONRY WALL
OLD PIPE
VALVE
CHAMBER
SEEPAGE
+
968.4
TAIL WATER
ABANDONED
PUMP
HOUSE
ROAD
BRANDONVILLE PUMPING
STATION DAM
Scale 1"=50'



SPILLWAY SECTION A-A
(No Scale)



A-13

PROFILE
LOOKING UPSTREAM

BRANDONVILLE PUMPING
STATION DAM
Scale 1"=60'

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Brandonville Pumping Station Dam

ID# PA 661

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

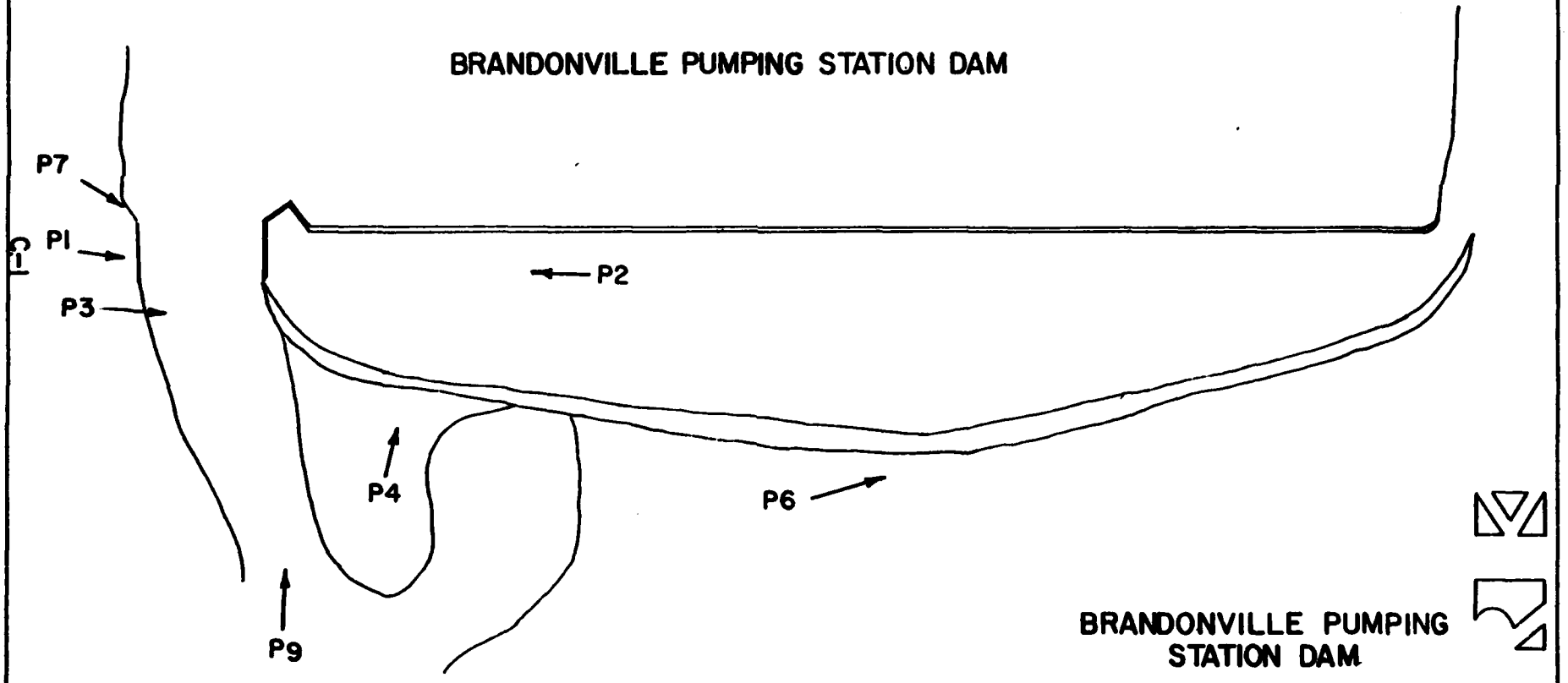
ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Puddle corewall constructed beneath the spillway in 1914. Other modifications unknown.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS

P — INDICATES PHOTO LOCATION



BRANDONVILLE PUMPING STATION DAM

PHOTO INDEX

BRANDONVILLE PUMPING STATION

Photograph Descriptions

Sheet 1. Front

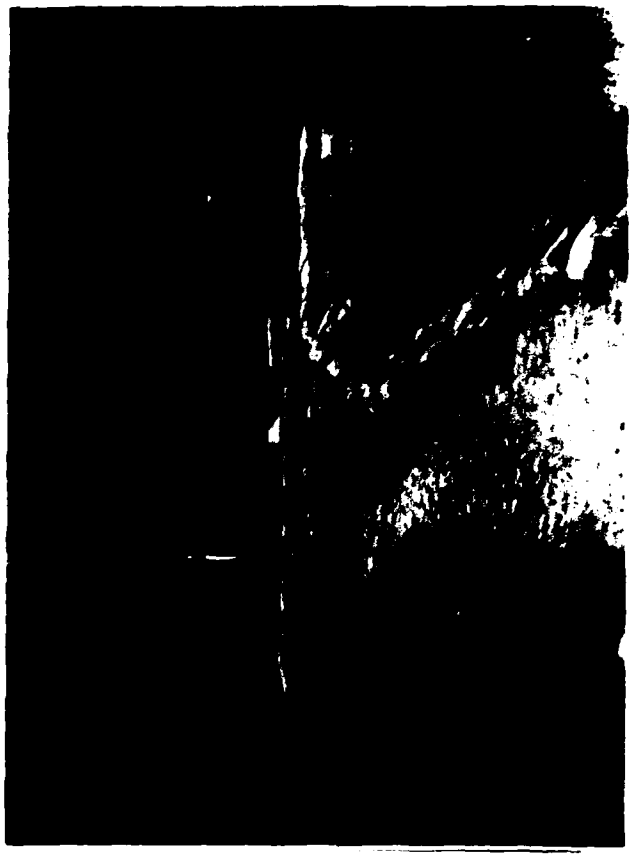
(1) Upper left - Crest and upstream slope from right abutment.
(2) Upper right - Right abutment of dam and spillway.
(3) Lower left - Downstream slope of dam adjacent to spillway.
(4) Lower right - Downstream slope of dam and access to valve house.

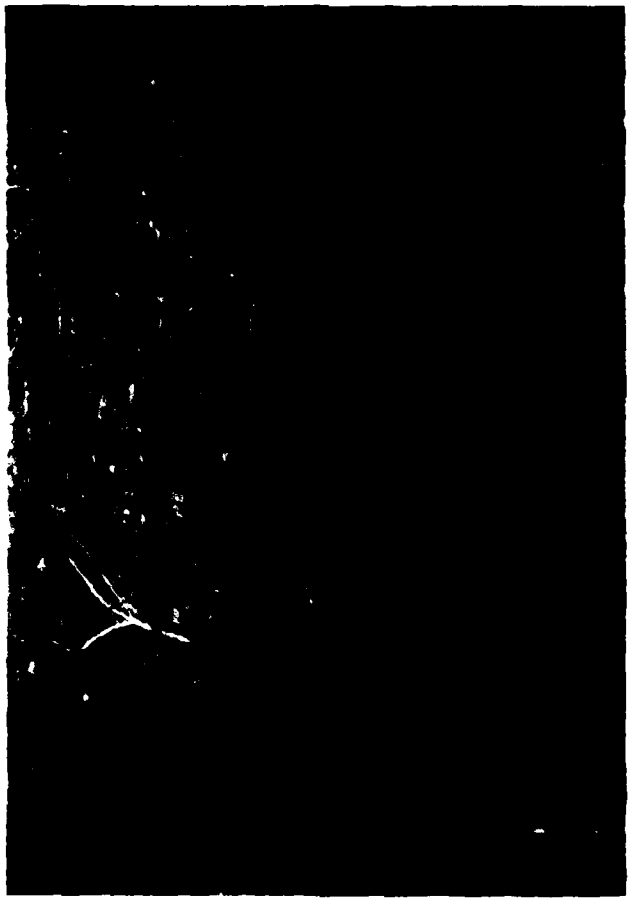
Sheet 1. Back

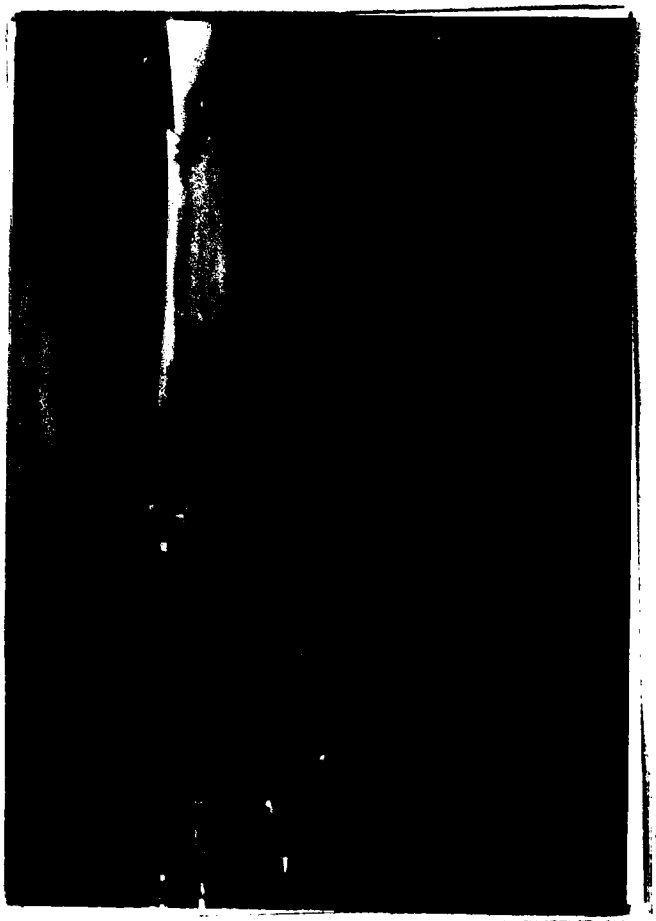
(5) Lower right - Overview of downstream exposure.

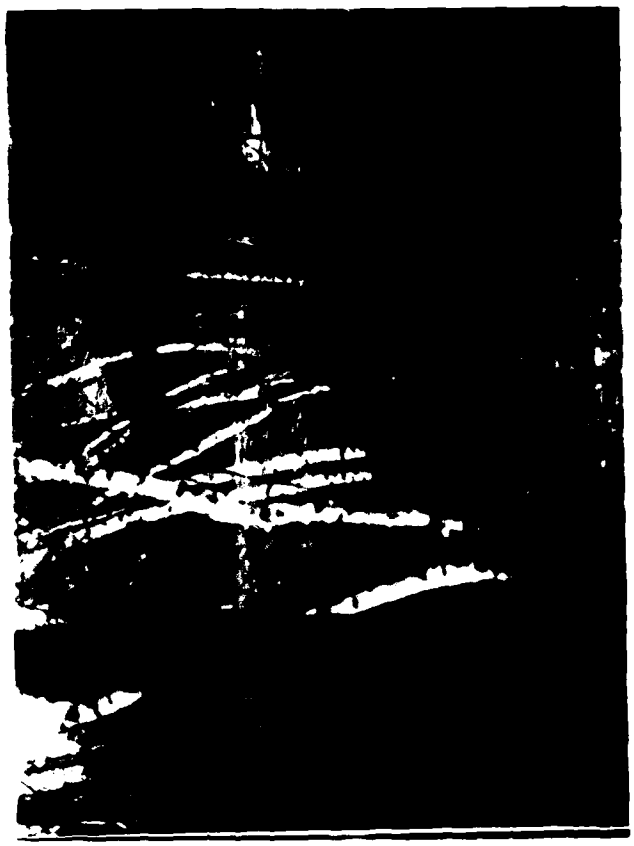
Sheet 2. Front

(6) Upper left - Downstream slope of dam near abutment.
(7) Upper right - Spillway weir and footbridge over spillway.
(8) Lower left - Downstream exposure cottage 2.9 miles downstream.
(9) Lower right - Spillway and right abutment viewed from downstream.









APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Brandonville Pumping Station Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (1.005) = 22.3"

STATION	1	2	3
Station Description	Brandonville (Sub-Area A)	Brandonville (Sub-Area B)	
Drainage Area (square miles)	1.0	1.9	
Cumulative Drainage Area (square miles)	1.0	2.9	
Adjustment of PMF for Drainage Area (%)[1]			
6 hours	117	117	
12 hours	127	127	
24 hours	136	136	
48 hours	143	143	
72 hours	145	145	
Snyder Hydrograph Parameters			
Zone[2]	13	13	
Cp [3]	0.50	0.50	
Ct [3]	1.85	1.85	
L (miles) [4]	1.6	2.2	
Lca (miles) [4]	0.8	0.9	
$tp = Ct(LxLca)^{0.3}$ hrs.	2.0	2.27	
Spillway Data			
Crest Length (ft)	40	40	
Freeboard (ft)	1.90	1.90	
Discharge Coefficient	3.4	3.4	
Exponent	1.5	1.5	

(1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: D.A.=2.9 mi^2 Wooded, moderate slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 62 ac.ft.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 70 ac.ft.

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 987.9 feet

SPILLWAY CREST:

a. Elevation 986 feet
b. Type Ogee
c. Width 40 feet
d. Length Unknown
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type CIP - Size unknown
b. Location Maximum section
c. Entrance inverts Unknown
d. Exit inverts Approximately 966 feet
e. Emergency draindown facilities Unknown

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME BRANDONVILLE DAM
I.D. NUMBER 54-48
SHEET NO. 1 OF 3
BY OTM DATE 1-22-80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT.

STRTL = 1 INCH
CNSTL = 0.05 IN/HR
STRTQ = 1.5 cfs/Mi²
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5 MIN. QUAD, DER. FILES AND FIELD INSPECTION DATA.

AT SPILLWAY CREST ELEVATION = 986'
INITIAL STORAGE = 62 Ac.Ft.
POND SURFACE AREA = 3.7 ACRES

AT ELEV. 1000', AREA = 14 ACRES
AT ELEV. 1020', AREA = 28 ACRES

FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (HEC-1), DAM SAFETY VERSION (USERS MANUAL).

$H = 3V/A$
$= 3(62)/3.7$
$= 186/3.7$
$= 50.27'$ USE 50'

ELEVATION WHERE AREA EQUALS ZERO:

986' - 50' = 936'

AREA	#A	0	3.7	14	28
ELEV.	#E	936	986	1000	1020

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EBENSBURG PENNSYLVANIA

DAM NAME BRANDONVILLE DAM
I.D. NUMBER 54-48
SHEET NO. 2 OF 3
BY OTM DATE 1-22-80

DISCHARGE RATING CURVE

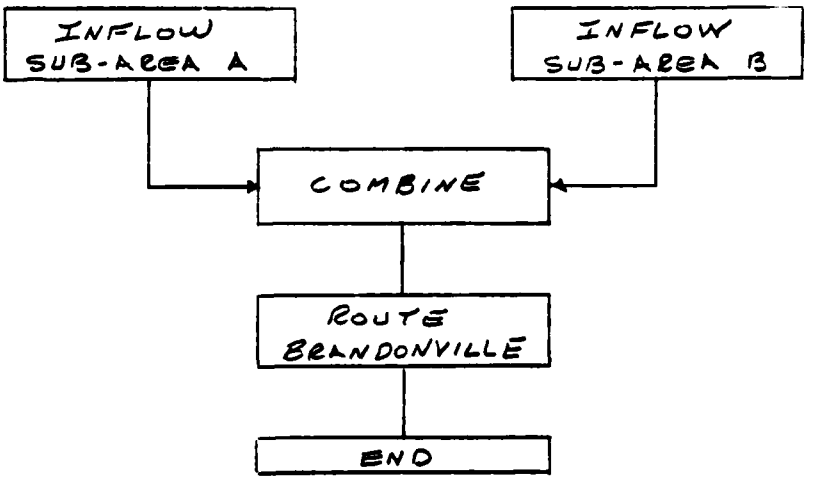
DETERMINED BY (HEC-1).

SPILLWAY CREST ELEV. = 986'
WEIR LENGTH = 40'
COEFFICIENT OF DISCHARGE = 3.4 (NEAR OGEE)

OVERTOP PARAMETERS

TOP OF DAM ELEV. (LOW SPOT) = 987.9'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 374'
COEFFICIENT OF DISCHARGE (C) = 3.0 (BROAD CREST)
$L_{MAX.}$ = 560'
$Y_{MAX.}$ = 1000'

PROGRAM SCHEDULE



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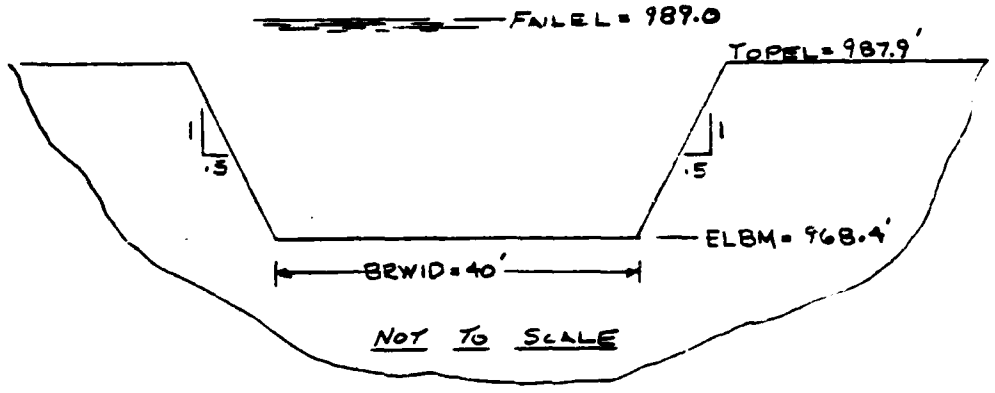
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME BRANDONVILLE DAM
I.D. NUMBER 54-48
SHEET NO. 3 OF 3
BY OTM DATE 1-22-80

DAM BREACH PARAMETERS



RATIO OF PMF (RTIO) = 0.20
SIDE SLOPE OF BREACH (Z) = 0.50
FAILURE TIME (TFAIL) = 2 HRS.

CHANNEL ROUTING

CHANNEL CROSS SECTIONS OBTAINED FROM U.S.G.S. QUAD.

CHANNEL MANNING'S n, QN(2) = 0.05

OVERBANK MANNING'S n, QN(1) = 0.06

1/6

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
     1          A1     ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
     2          A2     HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF BRANDONVILLE RESERVOIR
     3          A3     RATIOS OF PMF ROUTED THROUGH THE RESERVOIR  PA. 54-48
     4          B   288      0      15       0       0       0       0       0       0       0
     5          B1    5
     6          J     1      6       1
     7          J1  .1     .2      .3      .4      .5       1
     8          K     0      1                                       1
     9          K1      INFLOW SUB-AREA A
    10          M     1      1     1.0              2.9                                       1
    11          P           22.3    117     127     136     143     145
    12          T                                                  1.0    0.05
    13          W   2.0    0.50
    14          X  -1.5    -.05     2.0
    15          K     0      2                                       1
    16          K1      INFLOW SUB-AREA B
    17          M     1      1     1.9              2.9                                       1
    18          P           22.3    117     127     136     143     145
    19          T                                                  1.0    0.05
    20          W  2.27    0.50
    21          X  -1.5    -.05     2.0
    22          K     2      3                                       1
    23          K1      COMBINE SUB-AREA RUNOFF
    24          K     1      3
    25          K1      ROUTE THRU RESERVOIR
    26          Y                                 1       1
    27          Y1    1                                       -986
    28          SA    0    3.7      14      28
    29          SE  936    986    1000    1020
    30          SS  986     40     3.4     1.5
    31          SD 987.9    3.0     1.5     374
    32          SL   10     90     150     250     400     450     525     540     550     560
    33          SV 987.9    988     989     990     991     992     994     996     998    1000
    34          K    99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 80/01/15.
     TIME= 07.33.32.

                    ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
                    HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF BRANDONVILLE RESERVOIR
                    RATIOS OF PMF ROUTED THROUGH THE RESERVOIR  PA. 54-48

                                        JOB SPECIFICATION
                  NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
                 288        0       15        0        0        0        0        0        0        0
                                          JOPER      NWT    LROPT    TRACE
                                              5        0        0        0

                                  MULTI-PLAN ANALYSES TO BE PERFORMED
                                                NPLAN= 1 NRTIO= 6 LRTIO= 1
                          RTIOS=    .10      .20      .30      .40      .50     1.00

          **********      **********      **********      **********      **********

D-9                                 SUB-AREA RUNOFF COMPUTATION

                    INFLOW SUB-AREA A

                                ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                    1       0       0       0       0       0       1       0       0

                                        HYDROGRAPH DATA
                  IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO  ISNOW  ISAME  LOCAL
                      1       1   1.00     0.00    2.90    0.00   0.000      0      1      0

                                        PRECIP DATA
                                SPFE     PMS      R6     R12     R24     R48     R72     R96
                                0.00   22.30  117.00  127.00  136.00  143.00  145.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                        LOSS DATA
                  LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                      0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .05    0.00    0.00

                                    UNIT HYDROGRAPH DATA
                                TP=  2.00    CP=  .50    NTA=  0

                                    RECESSION DATA
                                STRTQ=  -1.50    QRCSN=   -.05    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 8.66 AND R=10.79 INTERVALS

                UNIT HYDROGRAPH 62 END-OF-PERIOD ORDINATES, LAG=  2.02 HOURS, CP=  .50  VOL= 1.00
      6.      24.      48.      77.     107.     133.     152.     163.     162.     151.
```

SUB-AREA RUNOFF COMPUTATION

3/6

D-10

INFLOW SUB-AREA B

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.90	0.00	2.90	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 2.27 CP= .50 NTA= 0

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-986.	0

SURFACE AREA=	0.	4.	14.	28.
CAPACITY=	0.	62.	178.	590.
ELEVATION=	936.	986.	1000.	1020.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
986.0	40.0	3.4	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
987.9	3.0	1.5	374.

CREST LENGTH	10.	90.	150.	250.	400.	450.	525.	540.	550.	560.
AT OR BELOW ELEVATION	987.9	988.0	989.0	990.0	991.0	992.0	996.0	996.0	998.0	1000.0

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 1.00
HYDROGRAPH AT	1	1.00	1	228.	456.	684.	913.	1141.	2281.
		2.59)		6.46))	12.92))	19.38))	25.84))	32.30))	64.60))
HYDROGRAPH AT	2	1.90	1	404.	808.	1213.	1617.	2021.	4042.
		4.92)		11.45))	22.89))	34.34))	45.78))	57.23))	114.46))
2 COMBINED	3	2.90	1	629.	1258.	1887.	2516.	3145.	6290.
		7.51)		17.81))	35.62))	53.43))	71.25))	89.06))	178.12))
ROUTED TO	3	2.90	1	629.	1259.	1889.	2518.	3148.	6296.
		7.51)		17.82))	35.65))	53.48))	71.31))	89.13))	178.24))

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	986.00	986.00	987.90
STORAGE	62.	62.	70.
OUTFLOW	0.	0.	356.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	988.45	.55	72.	629.	4.50	42.00	0.00
.20	989.18	1.28	76.	1259.	8.25	42.00	0.00
.30	989.69	1.79	79.	1889.	10.25	42.00	0.00
.40	990.09	2.19	81.	2518.	11.75	42.00	0.00
.50	990.43	2.53	83.	3148.	12.75	42.00	0.00
1.00	991.61	3.71	91.	6296.	17.00	42.00	0.00

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
     1          A1       RATIO OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
     2          A2       DOWNSTREAM CONDITION DUE TO OVERTOP (BRANDONVILLE DAM - 54-481)
     3          A3       PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH
     4          B    288      0       15       0        0        0        0        0        0        0
     5          B1     5
     6          J    2        1        1
     7          J1   .2
     8          K    0        1                                                  1
     9          K1       INFLOW SUB-AREA A
    10          M    1        1       1.0               2.9                                      1
    11          P             22.3     117      127      136      143      145
    12          Y                                                             1.0     0.05
    13          W    2.0      0.50
    14          X    -1.5     -.05     2.0
    15          K    0        2                                                  1
    16          K1       NFLOW SUB-AREA B
    17          M    1        1       1.9               2.9                                      1
    18          P             22.3     117      127      136      143      145
    19          Y                                                             1.0     0.05
    20          W    2.27     0.50
    21          X    -1.5     -.05     2.0
    22          K    2        3                                                  1
    23          K1       COMBINE SUB-AREA RUNOFF
    24          K    1        3
    25          K1       ROUTE THRU RESERVOIR
    26          Y                                  1        1
    27          Y1   1                                                        -986
    28          SA   0        3.7      14       28
    29          SE   936      986      1000     1020
    30          SS   986      40       3.4      1.5
    31          SD   987.9    3.0      1.5      374
    32          SL   10       90       150      250      400      450      525      540      550      560
    33          SV   987.9    988      989      990      991      992      994      996      998      1000
    34          SB   40       .5       968.4    2        986      989
    35          SB   40       .5       968.4    2        986      995
    36          K    1        4                                                  1
    37          K1       CHANNEL ROUTING  MOD-PULS REACH NO 1
    38          Y                                  1        1
    39          Y1   1
    40          Y6   .06      .05      .06      948      980      2000     0.0100
    41          Y7   0        980      300      950      650      950      655      944      695      948
    42          Y7   700      950      950      960      1050     980
    43          K    .1       5                                                  1
    44          K1       CHANNEL ROUTING  MOD-PULS REACH NO 2
    45          Y                                  1        1
    46          Y1   1
    47          Y6   .06      .05      .06      928      940      2500     0.0040
    48          Y7   0        980      75       960      200      940      205      938      245      938
    49          Y7   250      940      700      960      800      980
    50          K    1        6                                                  1
```

```
51          K1    CHANNEL ROUTING  MOD-PULS REACH NO 3
52          Y                                    1       1
53          Y1    1
54          Y6   .06      .05      .06      918      960      5000   0.0040
55          Y7    0       960      200      940      590      920     595      918      635      918
56          Y7   640      920      810      940      850      960
57          K     1        7                                        1
58          K1    CHANNEL ROUTING  MOD-PULS REACH NO 4
59          Y                                    1       1
60          Y1    1
61          Y6   .06      .05      .06      893      920      5000   0.0040
62          Y7    0       920      100      900      105      895     110      893      150      893
63          Y7   155      895      800      900     1000      920
64          K     99
```

DTS

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE= 80/01/21.
TIME= 06.00.49.

RATIO OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITION DUE TO OVERTOP (BRANDONVILLE DAM - 54-48)
PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
248	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .20

SUB-AREA RUNOFF COMPUTATION

INFLOW SUB-AREA A

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.00	0.00	2.90	0.00	0.000	0	100	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.00 CP= .50 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 8.66 AND R=10.79 INTERVALS

UNIT HYDROGRAPH 62 END-OF-PERIOD ORDINATES, LAG= 2.02 HOURS, CP= .50 VOL= 1.00

6.	24.	48.	77.	107.	133.	152.	163.	162.	151.

SUB-AREA RUNOFF COMPUTATION

NFLOW SUB-AREA B

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.90	0.00	2.90	0.00	0.000	0	100	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 2.27 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 9.78 AND R=12.25 INTERVALS

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	0	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-986.	0

SURFACE AREA=	0.	4.	14.	28.
CAPACITY=	0.	82.	178.	590.
ELEVATION=	936.	986.	1000.	1020.

CREL	SPWID	COOL	EXPW	ELEVL	COOL	CAREA	EXPL
986.0	40.0	3.4	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
987.9	3.0	1.5	550.

CREST LENGTH AT OR BELOW ELEVATION	10.	90.	150.	250.	400.	450.	525.	540.	550.	560.
	987.9	988.0	989.0	990.0	991.0	992.0	994.0	996.0	998.0	1000.0

DAM BREACH DATA

BRWID	Z	TFAIL	IFAIL	WSEL	FAILEL
40.	.50	968.40	2.00	986.00	989.00

6/12

HYDROGRAPH ROUTING

CHANNEL ROUTING MOD-PULS REACH NO 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	968.0	980.0	2000.	.01000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 980.00 300.00 960.00 650.00 950.00 655.00 948.00 695.00 948.00
700.00 950.00 950.00 960.00 1050.00 980.00

STORAGE	0.00	3.42	9.85	23.98	45.91	75.66	113.23	158.61	209.81
263.65	320.10	379.16	440.82	505.08	571.95	641.42	713.50	788.18	865.47
945.36									
OUTFLOW	0.00	293.01	1116.37	2971.38	6339.58	11621.22	19174.16	29328.35	43713.35
61027.61	81020.81	103677.33	129000.54	157006.51	187720.03	221172.16	257398.56	296438.29	338332.98
383126.20									
STAGE	946.00	949.68	951.37	953.05	954.74	956.42	958.11	959.79	961.47
963.16	964.84	966.53	968.21	969.89	971.58	973.26	974.95	976.63	978.32
980.00									
FLOW	0.00	293.01	1116.37	2971.38	6339.58	11621.22	19174.16	29328.35	43713.35
61027.61	81020.81	103677.33	129000.54	157006.51	187720.03	221172.16	257398.56	296438.29	338332.98
383126.20									

CHANNEL ROUTING MOD-PULS REACH NO 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

ON(1)	ON(2)	ON(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	938.0	980.0	2500.	.00400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 980.00 75.00 960.00 200.00 940.00 205.00 938.00 245.00 948.00
250.00 440.00 700.00 960.00 500.00 980.00

STORAGE	0.00	5.81	16.95	36.15	63.42	98.75	142.15	193.60	253.12
320.70	396.34	476.98	560.07	645.61	733.61	824.06	916.96	1012.32	1110.13
1210.40									
OUTFLOW	0.00	298.97	1178.35	2920.60	5788.96	10013.18	15804.55	23356.49	32857.73
44484.38									

HYDROGRAPH ROUTING

CHANNEL ROUTING MOD-PULS REACH NO 3

ISTAO	ICOMP	ICON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ALL PEAKS HAVE SAME

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	918.0	960.0	5000.	.00400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 960.00 200.00 945.00 590.00 920.00 595.00 918.00 635.00 918.00
640.00 920.00 810.00 940.00 850.00 960.00

STORAGE	0.00	11.61	33.64	71.38	124.83	193.98	278.83	379.39	495.65
1627.62	775.28	933.75	1098.94	1270.87	1449.52	1634.91	1827.02	2025.87	2231.46
2443.76									
OUTFLOW	0.00	298.97	1174.49	2898.82	5727.30	9883.10	15570.62	22980.85	32294.47
43689.79	57394.32	74998.46	94829.94	116882.76	141162.12	167681.09	196458.44	227517.13	260883.35
296585.71									
STAGE	918.00	920.21	922.42	924.63	926.84	929.05	931.26	933.47	935.68
937.89	940.11	942.32	944.53	946.74	948.95	951.16	953.37	955.58	957.79
960.00									
FLOW	0.00	298.97	1174.49	2898.82	5727.30	9883.10	15570.62	22980.85	32294.47
43689.79	57394.32	74998.46	94829.94	116882.76	141162.12	167681.09	196458.44	227517.13	260883.35
296585.71									

HYDROGRAPH ROUTING

CHANNEL ROUTING MOD-PULS REACH NO 4

9/12

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	1	0	0	0	0	1	0	0

ALL REACHS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	893.0	920.0	5800.	.00400

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CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 920.00 100.00 900.00 105.00 895.00 110.00 893.00 150.00 893.00
155.00 895.00 800.00 900.00 1000.00 920.00

STORAGE	0.00	8.24	23.73	71.38	153.99	271.46	406.23	545.02	687.89
834.77									
	985.61	1140.53	1299.51	1462.51	1629.54	1800.60	1975.70	2154.82	2337.99
2525.18									
OUTFLOW	0.00	138.86	511.62	1531.97	3669.87	7356.85	13488.14	21202.97	30391.87
40986.49									
	52940.73	66222.37	80808.64	96683.53	113836.09	132259.23	151948.92	172903.54	195123.49
218610.77									
STAGE	893.00	894.42	895.84	897.26	898.68	900.11	901.53	902.95	904.37
905.79									

	907.21	908.63	910.05	911.47	912.89	914.32	915.74	917.16	918.58
920.00									
FLOW	0.00	138.86	511.62	1531.97	3669.87	7356.85	13488.14	21202.97	30391.87
40986.49									
	52940.73	66222.37	80808.64	96683.53	113836.09	132259.23	151948.92	172903.54	195123.49
218610.77									

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20
HYDROGRAPH AT	1	1.00 (2.59)	1	456. (12.92)
			2	456. (12.92)
HYDROGRAPH AT	2	1.90 (4.92)	1	808. (22.89)
			2	808. (22.89)
2 COMBINED	3	2.90 (7.51)	1	1258. (35.62)
			2	1258. (35.62)
ROUTED TO	3	2.90 (7.51)	1	1650. (46.72)
			2	1259. (35.65)
ROUTED TO	4	2.90 (7.51)	1	1641. (46.46)
			2	1258. (35.61)
ROUTED TO	5	2.90 (7.51)	1	1627. (46.06)
			2	1254. (35.51)
ROUTED TO	6	2.90 (7.51)	1	1594. (45.14)
			2	1240. (35.11)
ROUTED TO	7	2.90 (7.51)	1	1494. (42.30)
			2	1189. (33.66)

D-23

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	986.00	986.00	987.90
STORAGE	62.	62.	70.
OUTFLOW	0.	0.	356.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	989.08	1.18	78.	1862.	2.92	42.13	41.25

PLAN 2 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	986.00	986.00	987.90
STORAGE	62.	62.	70.
OUTFLOW	0.	0.	356.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	989.18	1.28	76.	1259.	8.25	42.00	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1641.	951.8	42.75

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1258.	951.5	42.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1627.	964.0	42.50

PLAN 2 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1256.	957.6	42.25

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1594.	923.0	42.75

PLAN 2 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1240.	922.5	42.50

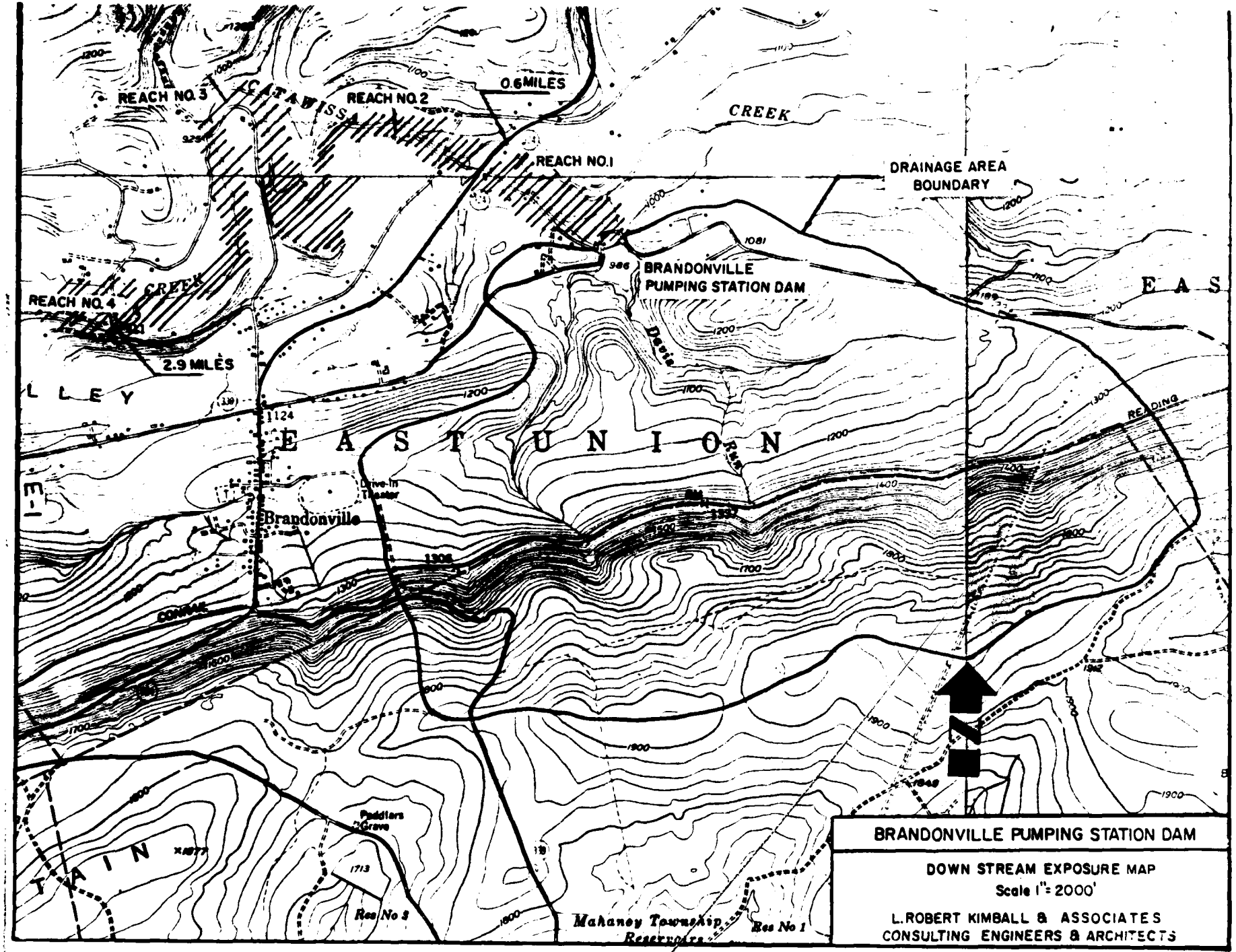
PLAN 1 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1456.	897.2	43.25

PLAN 2 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1139.	896.8	43.25

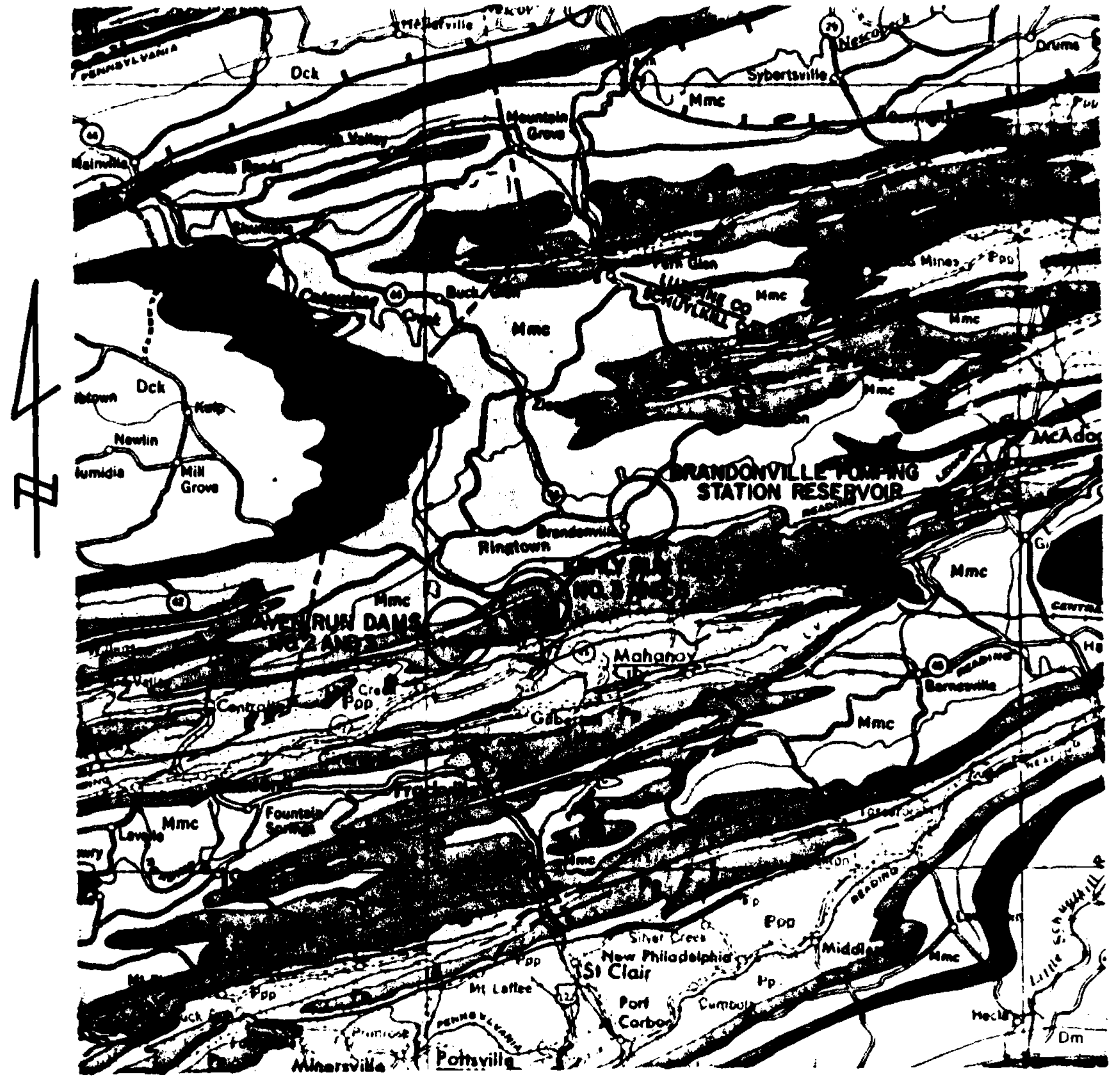
APPENDIX E
DRAWINGS


REACH NO. 3
CATAWISSA
REACH NO. 2
0.6 MILES
CREEK
REACH NO. 1
DRAINAGE AREA
BOUNDARY
BRANDONVILLE
PUMPING STATION DAM
HILL CREEK
REACH NO. 4
2.9 MILES
EAST UNION
Brandonville
Drive-In Theater
CONRAIL
Paddlers Grove
Res No 3
Mahaney Township
Reservoirs
Res No 1
READING
BRANDONVILLE PUMPING STATION DAM
DOWN STREAM EXPOSURE MAP
Scale 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

Brandonville Pumping Station Reservoir - General Geology

The Brandonville Pumping Station Reservoir and dam are located in the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This province is typified by numerous synclinal and anticlinal features. No major faulting is indicated in the vicinity of the reservoir. The bedrock underlying the reservoir and dam consists of the Mississippian aged Manch Chunk formation. This unit consists of moderately well-bedded reddish shale, claystone, sandstone and siltstone. The sandstones and siltstones are commonly crossbedded. Joints are moderately well formed, abundant and regularly spaced.



GEOLOGIC MAP OF THE AREA SURROUNDING RAVEN RUN DAMS NO. 2 AND 3, KEHLY RUN DAMS NO. 3 AND 5, BRANDONVILLE PUMPING STATION RESERVOIR

Pottsville Group
Predominantly sandstones and conglomerates with thin shales and coals, some coals mineable locally.

ANTHRACITE REGION

Ppp — **Post-Pottsville Formations**
Brown or gray sandstones and shales with some conglomerate and numerous mineable coals

Pottsville Group
Light gray to white, coarse grained sandstones and conglomerates with some mineable coal; includes ... Schuylkill, and Tumbling Run Formations

MISSISSIPPIAN

Mmc — **Mauch Chunk Formation**
[illegible]

F-2

SCALE 1:250,000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DTIC